4C Petroleum and Coal Products (SIC Code 29)

EPA's *Industry Screener Questionnaire: Phase I Cooling Water Intake Structures* identified two 4-digit SIC codes in the Petroleum and Coal Products Industry (SIC 29) with at least one existing facility that operates a CWIS, holds a NPDES permit, and withdraws more than two million gallons per day (MGD) from a water of the United States, and uses at least 25 percent of its intake flow for cooling purposes (facilities with these characteristics are hereafter referred to as "§316(b) facilities"). For both SIC codes, Table 4C-1 below provides a description of the industry sector, a list of primary products manufactured, the total number of screener respondents, and the number and percent of §316(b) facilities.

Table 4C-1: §316(b) Facilities in the Petroleum and Coal Products Industry (SIC 29): Weighted Screener Survey Respondents

SIC	SIC Description	Important Products Manufactured	Number of Facilities		
			Total	§316(b) Facilities	
				No.†	%
2911	Petroleum Refining	Gasoline, kerosene, distillate fuel oils, residual fuel oils, and lubricants, through fractionation or straight distillation of crude oil, redistillation of unfinished petroleum derivatives, cracking, or other processes; aliphatic and aromatic chemicals as byproducts	163	28	17.2%
2999	Products of Petroleum and Coal, Not Elsewhere Classified	Packaged fuel, powdered fuel, and other products of petroleum and coal, not elsewhere classified	8	1	12.5%
Total Petroleum and Coal Products (SIC 29)					
Total 29			**171**	**29**	**15.8%**

† Information on the percentage of intake flow used for cooling purposes was not available for all screener respondents. Facilities for which this information was not available were assumed to use at least 25% of their intake flow for cooling water purposes The reported numbers of §316(b) facilities may therefore be overstated.

Source: EPA, Industry Screener Questionnaire: Phase I Cooling Water Intake Structures; Executive Office of the President, Office of Management and Budget, Standard Industrial Classification Manual 1987

Responses to the Screener Questionnaire indicate that one sector, Petroleum Refining (SIC code 2911), accounts for 97 percent of the §316(b) facilities in SIC 29. This profile therefore focuses on facilities in the Petroleum Refining sector.

4C.1 Domestic Production

The petroleum refining industry accounts for about 4 percent of the value of shipments of the entire manufacturing sector and for 0.4 percent of the manufacturing sector's employment (U.S. Department of Energy, 1999a). According to the Annual Survey of Manufactures, petroleum refineries had a value of shipments of approximately $158 billion dollars ($1996) and employed 67,200 people (U.S. DOC 1996). Petroleum products contribute approximately 40 percent of the total energy used in the United States, including virtually all of the energy consumed in transportation (U.S. Department of Energy, 1999a).

U.S. DOE Energy Information Administration (EIA) data report that there were 159 operable petroleum refineries in the U.S. as of January 1999, of which 155 were operating and four were idle.[1] Some data reported in this profile are taken from EIA publications. Readers should keep in mind that the Census data reported for SIC code 2911 cover a somewhat broader range of facilities than do the DOE/EIA data, and the two data sources are therefore not entirely

[1] In addition, there are two operating refineries in Puerto Rico and one in the Virgin Islands.

comparable.[2]

The petroleum industry includes exploration and production of crude oil, refining, transportation and marketing. Petroleum refining is a capital-intensive production process that converts crude oil into a variety of refined products. Refineries range in complexity, depending on the types of products produced. Nearly half of all U.S. refinery output is motor gasoline.

The number of U.S. refineries has declined by almost half since the early 1980s. The remaining refineries have improved their efficiency and flexibility to process heavier crude oils, by adding "downstream" capacity.[3] While the number of refineries has declined, the average refinery capacity and utilization has increased, resulting in an increase in domestic refinery production overall.

a. Output

Nominal ***value of shipments*** and ***value added*** for petroleum refineries increased by 33 and 26 percent, respectively, from 1988 to 1996.[4] Adjusted for changes in petroleum product prices, real value of shipments was fairly constant over this period, despite a decline in the number of operating refineries (see Figure 4C-1).

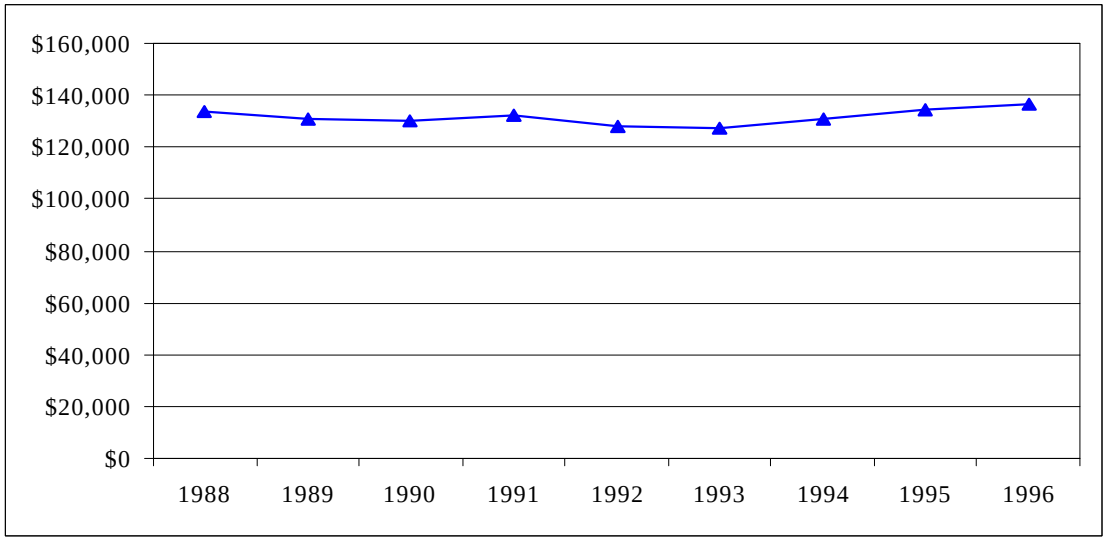
[2] For comparison, preliminary 1997 Census data included 244 establishments for NAICS 3241/SIC 2911, whereas DOE/EIA reported 164 operable refineries as of January 1997.

[3] The first step in refining is atmospheric distillation, which uses heat to separate various hydrocarbon components in crude oil. Beyond this basic step are more complex units (generally referred to as "downstream" from the initial distillation) that increase the refinery's capacity to produce a wide range of crude oils and increase the yield of lighter (low-boiling point) products such as gasoline. These downstream operations include vacuum distillation, cracking units, reforming units and other processes (U.S. Department of Energy, 1999a).

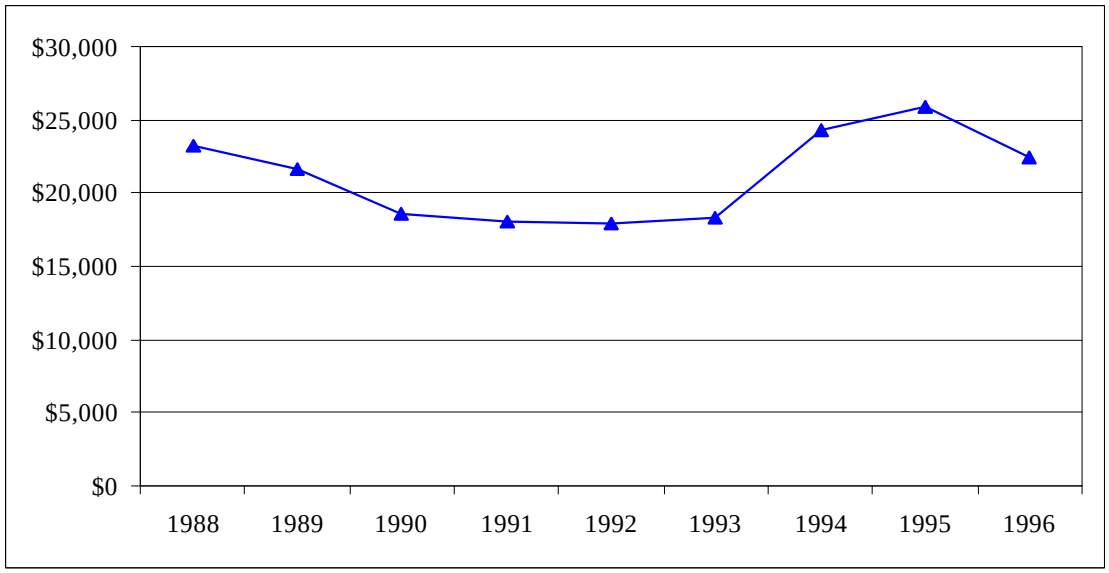
[4] Terms highlighted in bold and italic font are further explained in the glossary.

Figure 4C-1: Value of Shipments and Value Added for Petroleum Refineries ($1999 million)

Value of Shipments ($1999 million)



Value Added ($1999 millions)



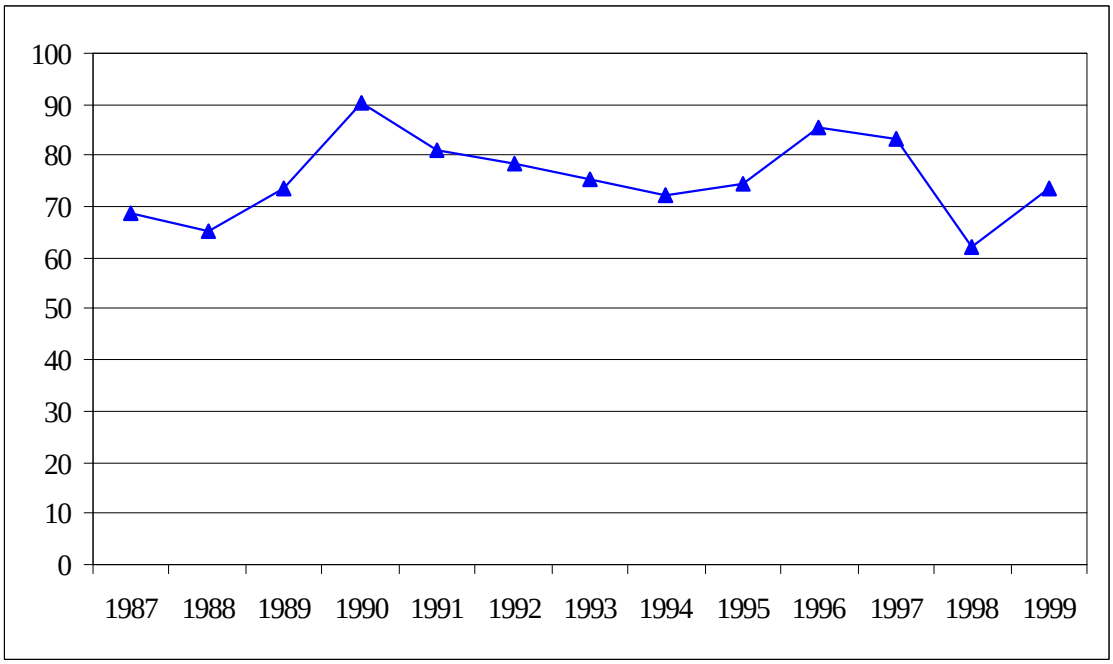
Source: Department of Commerce, Bureau of the Census, Annual Survey of Manufactures

b. Prices

Figure 4C-2 shows the ***producer price index*** (PPI) for the Petroleum Refinery sector. The PPI is a family of indexes that measure price changes from the perspective of the seller. This profile uses the PPI to inflate nominal monetary values to constant dollars.

The PPI for refined petroleum products showed substantial fluctuations in petroleum product prices between 1988 and 1999, as shown in Figure 4C-2.

Figure 4C-2: Producer Price Index for Petroleum Refineries

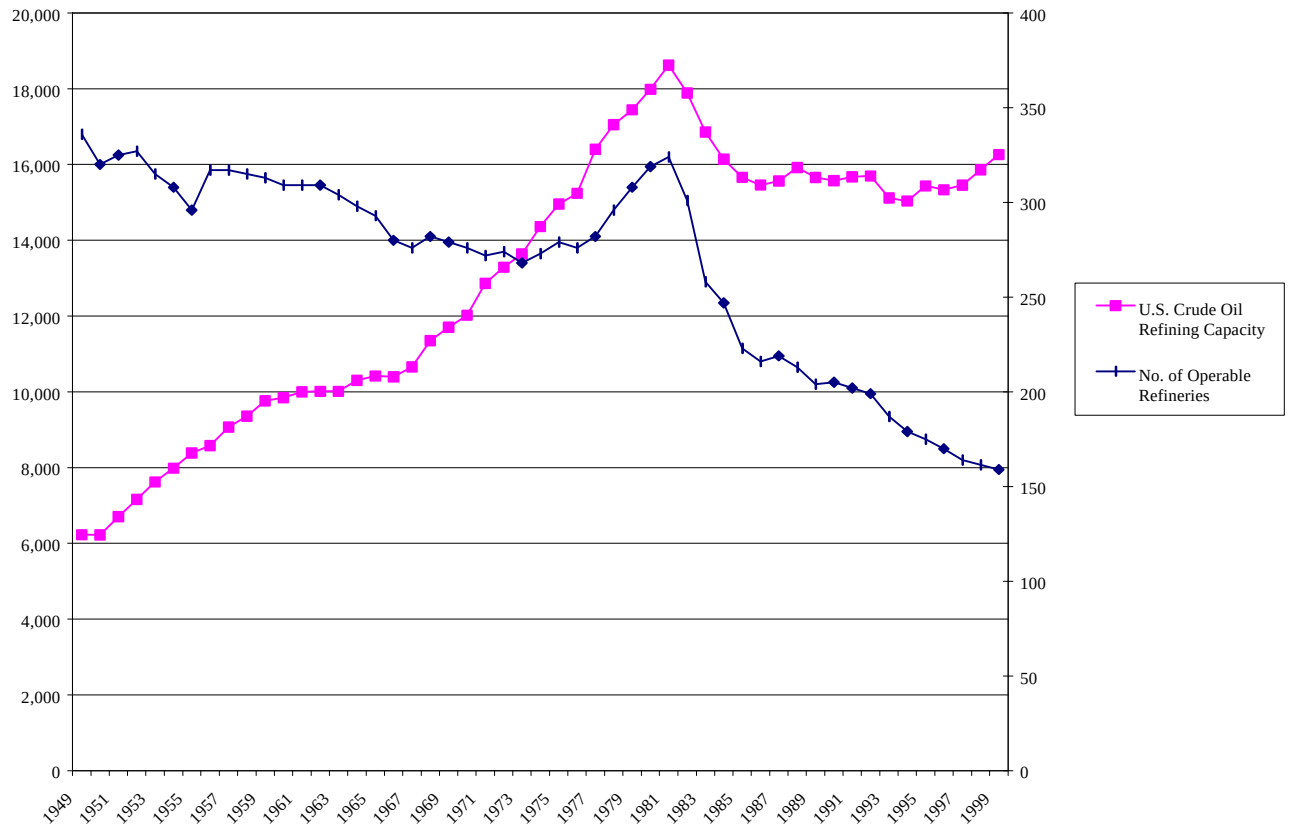


Source: Bureau of Labor Statistics, Producer Price Index.

c. Number of Facilities and Firms

Figure 4C-3 shows historical trends in the numbers of refineries and refinery capacity. This figure shows that the number of operable refineries fell substantially between 1980 and 1999. This decrease resulted in part from the elimination of the Crude Oil Entitlements Program in the early 1980s. The Entitlements Program encouraged smaller refineries to add capacity throughout the 1970s. After the program was eliminated, surplus capacity and falling profit margins led to the closure of the least efficient capacity (U.S. Department of Energy, 1999a).

Figure 4C-3: Trends in Numbers of Refineries and Refining Capacity



† Capacity data were not compiled in 1998. Estimates shown here for that date are the average of the 1997 and 1999 values.

Source: U.S. Department of Energy, Energy Information Administration, Petroleum Supply Annual, various years.

Data from the Statistics of U.S. Businesses for SIC 2911 (Table 4C-2) shows that the number of firms reporting petroleum refining as their primary business has also declined overall since 1990.

Table 4C-2: Number of Firms and Facilities for Petroleum Refineries

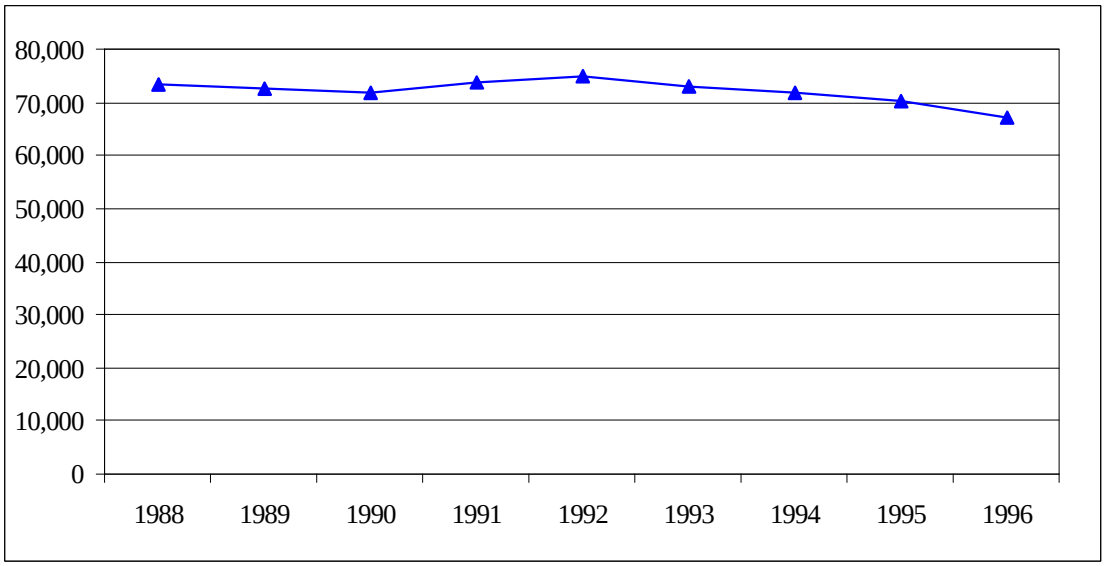
Year	Firms		Facilities	
	Number	Percent Change	Number	Percent Change
1990	215	n/a	340	n/a
1991	215	0%	346	2%
1992	185	-14%	303	-12%
1993	148	-20%	251	-17%
1994	161	9%	265	6%
1995	150	-7%	251	-5%
1996	173	15%	275	10%
Percent Change 1990 - 1997		-20%		-19%

Source: Small Business Administration, Statistics of U.S. Businesses.

d. Employment and Productivity

Employment levels in the petroleum refining industry declined by 8.2 percent between 1988 and 1996, to 67,200 employees, as shown in Figure 4C-4. After increasing in the early 1990s, employment at petroleum refineries has declined since 1992, reflecting overall industry consolidation.

Figure 4C-4: Employment for Petroleum Refineries



Source: Department of Commerce, Bureau of the Census, Annual Survey of Manufactures.

Production hours have remained stable between 1988 and 1996. There has been no change in total production hours, and a net reduction of 3 percent in real value added per production hour over the same period (see Table 4C-3).

Table 4C-3: Productivity Trends for Petroleum Refineries

Year	Production Hours (mill.)	Value Added ($1999, millions)	Real Value Added/Hour ($ 1999)	Growth Rates		
				Production Hours	Value Added	Real Value Added/Hour
1988	16,020	114	226	n/a	n/a	n/a
1989	16,291	109	206	1.9%	-7.3%	-9.1%
1990	17,880	115	176	1.0%	-13.6%	-14.4%
1991	17,366	121	168	0.9%	-3.4%	-4.3%
1992	18,643	120	165	1.9%	-0.3%	-2.1%
1993	17,811	108	171	-1.8%	2.0%	3.9%
1994	16,703	101	221	2.8%	32.5%	28.9%
1995	16,561	100	242	-2.7%	6.9%	9.9%
1996	15,774	97	218	-3.7%	-13.5%	-10.1%
1988-1997 Growth Rate				0.0%	-3.6%	-3.6%

Source: Department of Commerce, Bureau of the Census, Annual Survey of Manufactures.

e. Capital Expenditures

Petroleum industry capital expenditures increased substantially between 1988 and 1996 in real terms: in 1996 the industry spent $4.5 billion in constant 1999 dollars, as compared with $2.6 billion (1999$) in 1988. Environmentally-related investments have accounted for a substantial portion of these capital expenditures. Figure 4C-5 shows pollution control expenditures reported by American Petroleum Institute (API) members (in current dollars). Expenditures to control current environmental releases (air, water and waste) account for the largest portion of total pollution control expenditures. Of the total 1996 expenditures, approximately 3.8 billion (72 percent) was related to control of air emissions from refineries.

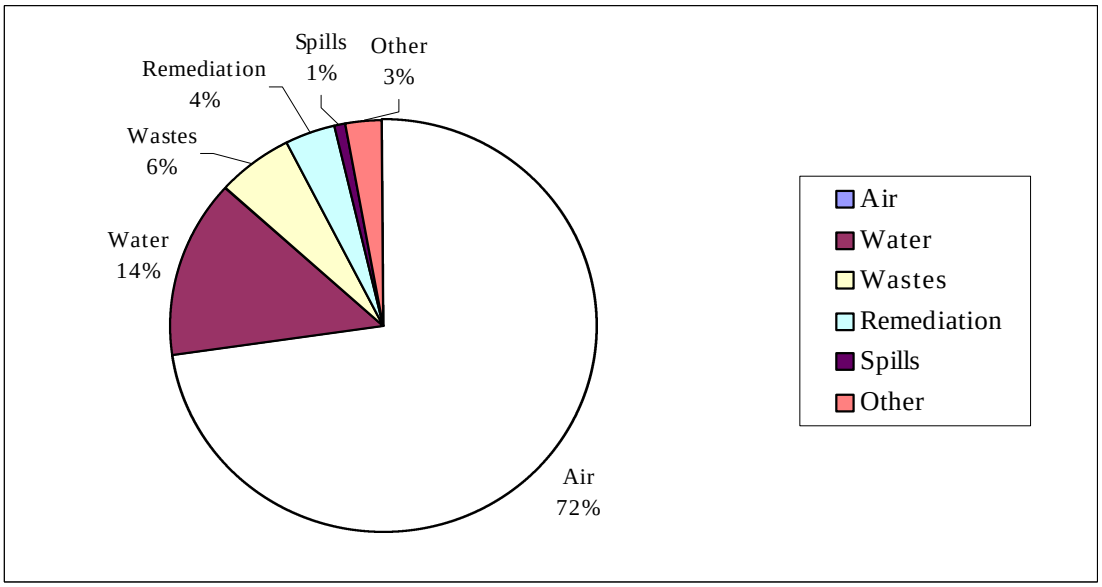
Table 4C-4: Capital Expenditures for Petroleum Refineries

Year	Capital Expenditures ($1999 millions)
1988	2,618
1989	2,987
1990	3,119
1991	5,095
1992	5,771
1993	5,858
1994	5,631
1995	5,805
1996	4,484

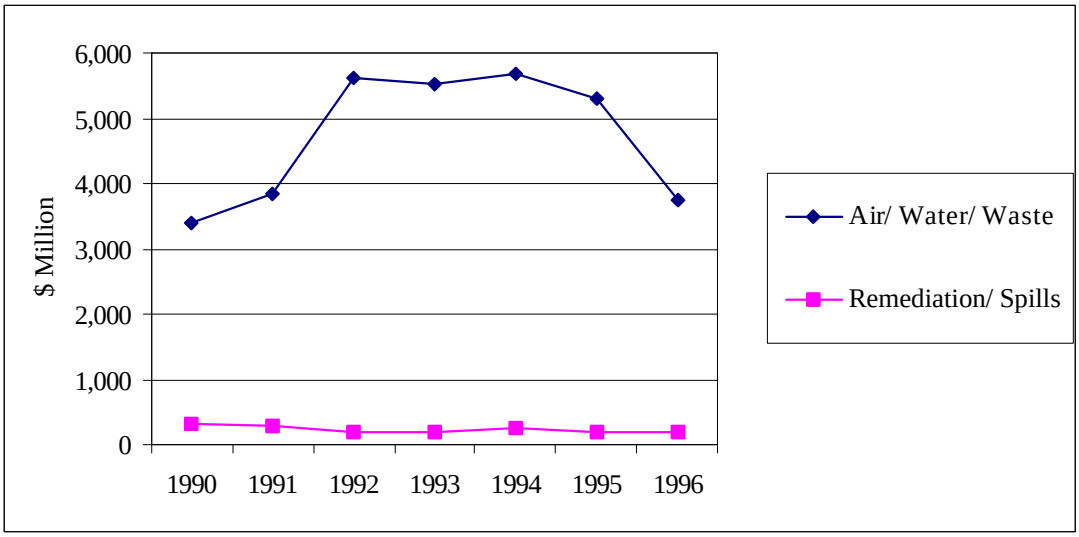
Source: Department of Commerce, Bureau of the Census, Annual Survey of Manufactures

Figure 4C-5: Environmental Expenditures by Type and Medium for Petroleum Refineries

By Type, 1966



By Medium



Source: American Petroleum Institute, STEP Report.

f. Capacity Utilization

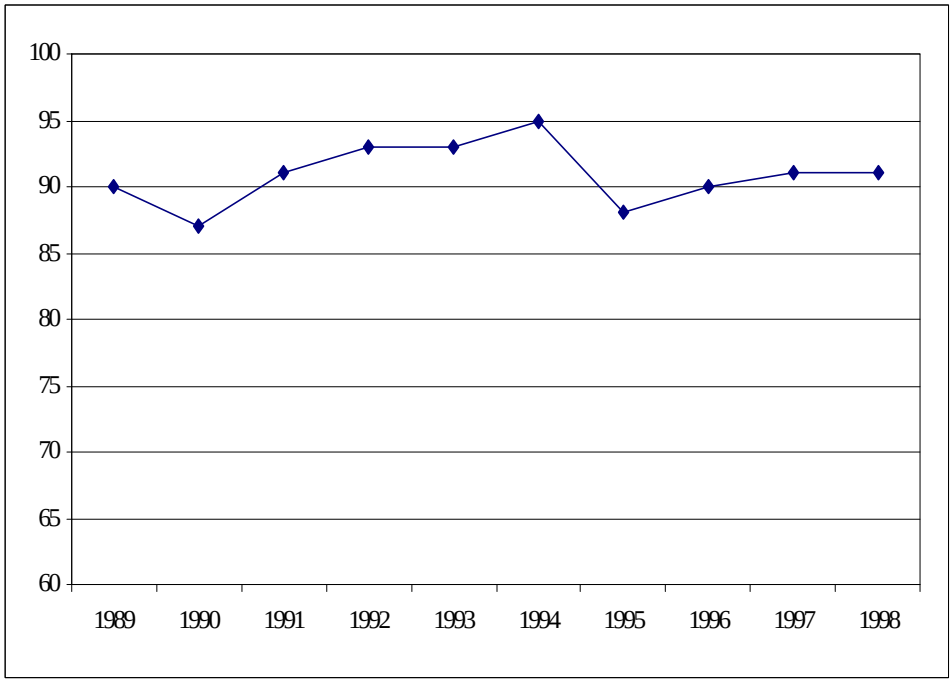
The most commonly-used measure of refinery capacity is expressed in terms of crude oil distillation capacity. EIA defines refinery capacity utilization as input divided by calendar day capacity. Calendar day capacity is the maximum amount of crude oil input that can be processed during a 24-hour period with certain limitations. Some downstream refinery capacities are measured in terms of "stream days", which is the amount a unit can process running full capacity under optimal crude and product mix conditions for 24 hours (U.S. DOE, 1999a). Downstream capacities are reported only for specific units or products, and are not summed across products, since not all products could be produced at the reported levels simultaneously.

Much recent investment in petroleum refineries has been to expand and de-bottleneck units downstream from distillation, partially in response to environmental requirements. Changes in refinery configurations have included adding catalytic cracking units, installing additional sulfur removal hydrotreaters, and using manufacturing additives such as oxygenates. These process changes have resulted from two factors:

- processing of heavier crudes with higher levels of sulfur and metals; and
- regulations requiring gasoline reformulation to reduce volatiles in gasoline and production of diesel fuels with reduced sulfur content (EPA/OSW 1996).

Figure 4C-6 below shows the increase in overall capacity utilization in the petroleum industry from 1987 to 1998, as reported by the Census Bureau. Figure 4C-6 shows that overall refinery utilization has remained high over this period. Utilization of specific portions of refinery capacities may vary, however, as the industry adjusts to changes in the desired product mix and characteristics.

Figure 4C-6: Capacity Utilization Index for Petroleum Refineries



Source: Department of Commerce, Bureau of the Census, Current Industrial Reports, Survey of Plant Capacity.

4C.2 Structure and Competitiveness of the Petroleum Industry

The petroleum refining industry in the United States is made up of integrated international oil companies, integrated domestic oil companies, and independent domestic refining/marketing companies. In general, the petroleum industry is highly integrated, with many firms involved in more than one sector. Large companies referred to as the "majors" are fully integrated across crude oil exploration and production, refining, and marketing. Smaller, nonintegrated companies referred to as the "independents" generally specialize in one sector of the industry.

Like the oil business in general, refining has been dominated in the 1990s by integrated internationals, specifically a few large companies such as Exxon Corporation, Mobil Corporation[5], and Chevron Corporation – all of which ranked in the top ten of Fortune's 500 sales ranking.

Substantial diversification by major petroleum companies into other energy and non-energy sectors was financed by high oil prices in the 1970s and 1980s. With lower profitability in the 1990s, the major producers began to exit nonconventional energy operations (e.g., oil shale) as well as coal and non-energy operations in the 1990s. Some have recently ceased chemical production.

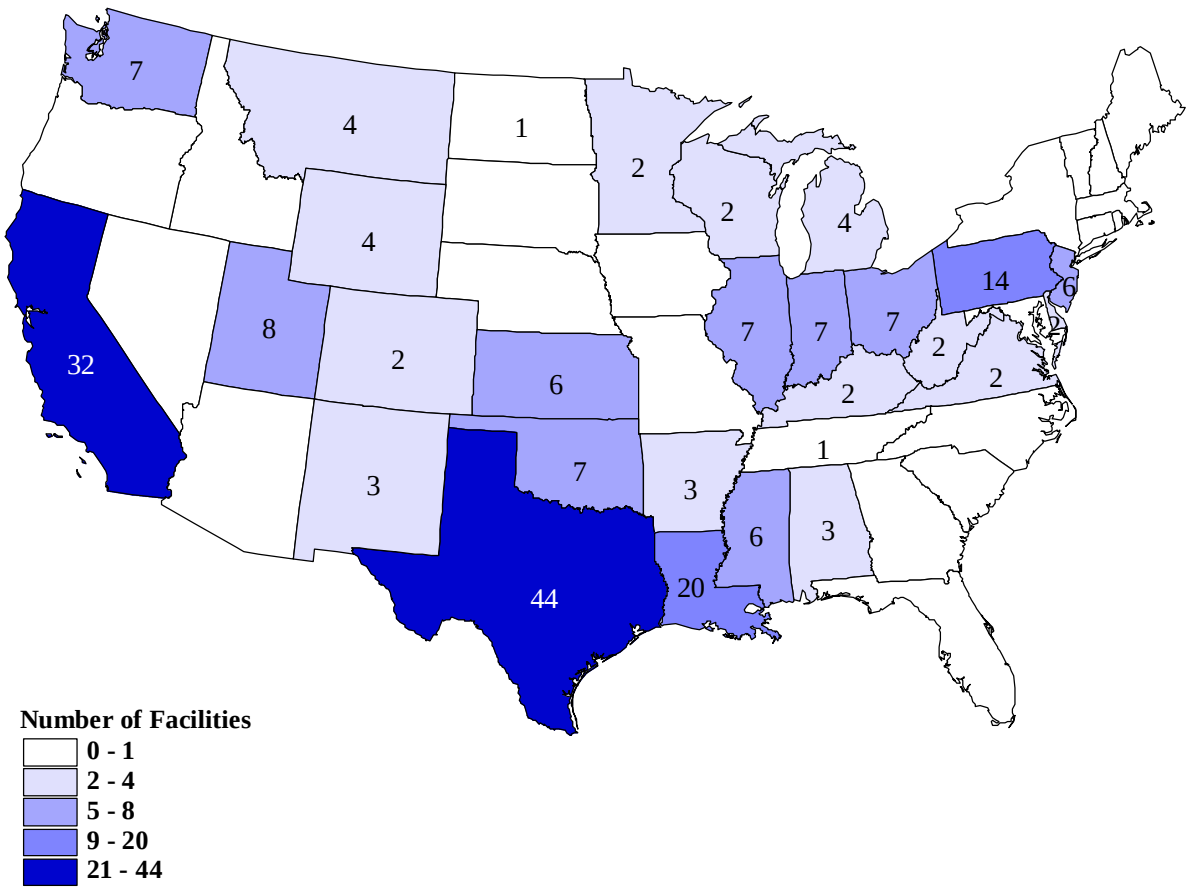
During the 1990s, several mergers, acquisitions, and joint ventures occurred in the petroleum refining industry in an effort to cut cost and increase profitability. This consolidation has taken place among the largest firms (as illustrated by the acquisition of Amoco Corporation by the British Petroleum and the mega-merger of Exxon and Mobil Corporation) as well as among independent refiners and marketers (e.g., the independent refiner/marketer Ultramar Diamond Shamrock (UDS) acquired Total Petroleum North America in 1997) (U.S. DOE, 1999b). BP Amoco recently announced a deal to sell its 250,000 barrel per day Alliance refinery in Louisiana to the leading U.S. independent refining and marketing company Tosco Corp.

[5] Exxon and Mobil Corporations have recently merged into one company.

a. Geographic Distribution

Petroleum refining facilities are concentrated in areas near crude oil sources and near consumers. The cost of transporting crude oil feed stocks and finished products is an important influence on the location of refineries. Most petroleum refineries are located along the Gulf Coast and near the heavily industrialized areas of both the east and west coasts (U.S. DOE, 1997b). Figure 4C-7 below shows the distribution of U.S. petroleum refineries. In 1992, there were 44 refineries in Texas, 32 in California, and 20 in Louisiana, accounting for 43 percent of all facilities in SIC code 2911 in the United States.

Figure 4C-7: Geographic Distribution of Petroleum Refineries

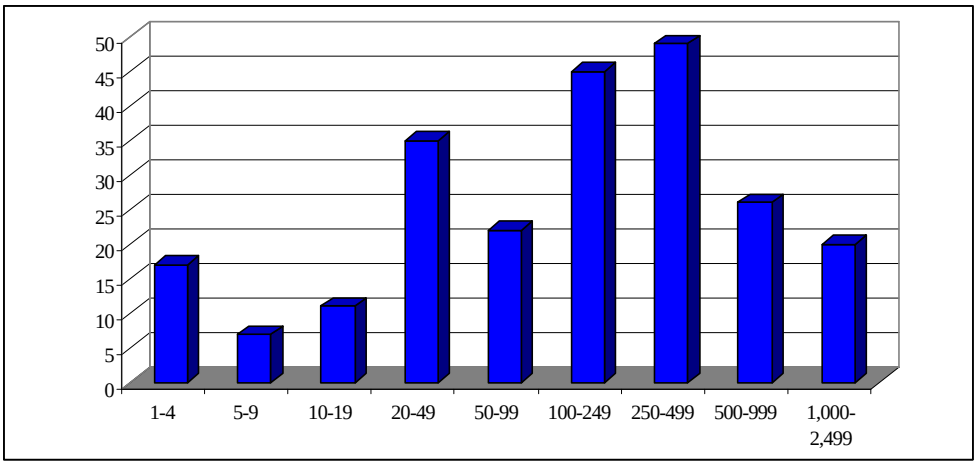


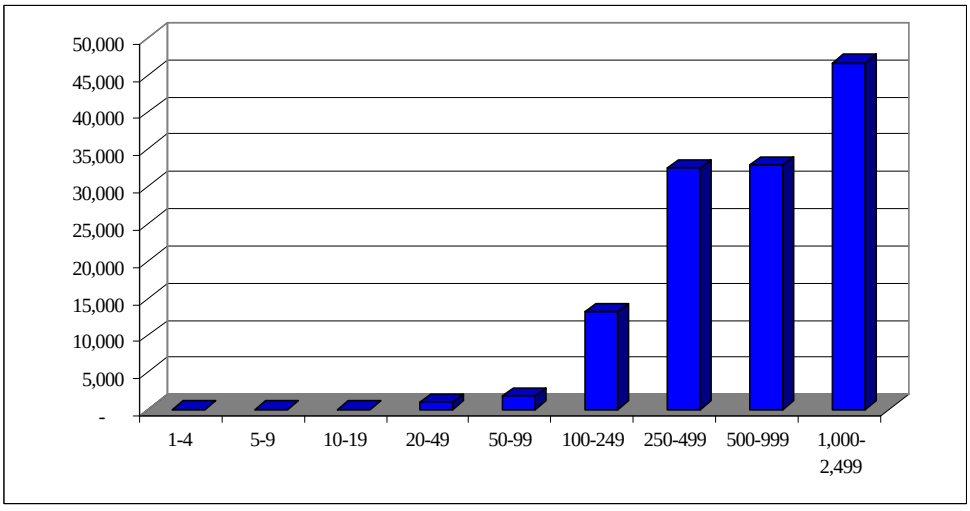
Source: Department of Commerce, Bureau of the Census, Census of Manufactures, 1992.

b. Establishment Size

A substantial portion of the facilities in SIC code 2911 are large facilities, with 41 percent having 250 or more employees. Figure 4C-8 shows that approximately 87 percent of the value of shipments for the industry is produced by the 41 percent of establishments with more than 250 employees. Establishments with more than 1,000 employees are responsible for approximately 36 percent of all industry shipments.

Figure 4C-8: Value of Shipments and Number of Facilities for Petroleum Refineries by Employment Size Category





Source: Department of Commerce, Bureau of the Census, Census of Manufactures, 1992.

c. Firm Size

The Small Business Administration defines a small firm for SIC code 2911 as a firm with 1,500 or fewer employees. The size categories reported in the Statistics of U.S. Businesses (SUSB) do not correspond with the SBA size classifications. It is therefore not possible to apply the SBA size threshold precisely. Table 4C-5 below shows the distribution of firms, establishments, and receipts in SIC code 2911 by the employment size of the parent firm. The SUSB data show that 122 of the 275 SIC 2911 establishments reported for 1996 (44 percent) are owned by very large firms (those with 2,500 employees or more), 127 (46 percent) are owned by small firms (those with fewer than 500 employees), and 26 establishments (9 percent) are owned by firms that are of unknown size but that are not very small (those with between 500 and 2,499 employees).

Table 4C-5: Number of Firms, Establishments, and Estimated Receipts for Petroleum Refineries by Firm Employment Size Category (1996)

Employment Size Category	Number of Firms	Number of Establishments	Estimated Receipts ($1999 millions)
0-19	66	67	300
20-99	23	24	1,019
100-499	29	36	6,065
500-2499	15	26	9,928
2500+	40	122	108,495
Total	173	275	125,808

Source: Small Business Administration, Statistics of U.S. Businesses.

d. Concentration and Specialization Ratios

Concentration is the degree to which industry output is concentrated in a few large firms. Concentration is closely related to entry and exit barriers with more concentrated industries generally having higher barriers.

The four-firm ***concentration ratio*** (CR4) and the ***Herfindahl-Hirschman Index*** (HHI) are common measures of industry concentration. The CR4 indicates the market share of the four largest firms. For example, a CR4 of 72 percent means that the four largest firms in the industry account for 72 percent of the industry's total value of shipments. The higher the concentration ratio, the less competition there is in the industry, other things being equal.[6] An industry with a CR4 of more than 50 percent is generally considered concentrated. The HHI indicates concentration based on the largest 50 firms in the industry. It is equal to the sum of the squares of the market shares for the largest 50 firms in the industry. For example, if an industry consists of only three firms with market shares of 60, 30, and 10 percent, respectively, the HHI of this industry would be equal to 4,600 ($60^2 + 30^2 + 10^2$). The higher the index, the fewer the number of firms supplying the industry and the more concentrated the industry. An industry is considered concentrated if the HHI exceeds 1,000.

The petroleum industry is considered competitive, based on C4 and the HHI. The CR4 and the HHI for SIC code 2911 are both below the benchmarks of 50 percent and 1,000, respectively.

The ***specialization ratio*** is the percentage of the industry's production accounted for by primary product shipments. The ***coverage ratio*** is the percentage of the

[6] Note that the measured concentration ratio and the HHF are very sensitive to how the industry is defined. An industry with a high concentration in domestic production may nonetheless be subject to significant competitive pressures if it competes with foreign producers or if it competes with products produced by other industries (e.g., plastics vs. aluminum in beverage containers). Concentration ratios are therefore only one indicator of the extent of competition in an industry.

industry's product shipments coming from facilities from the same primary industry. The coverage ratio provides an indication of how much of the production/product of interest is captured by the facilities classified in an SIC code. The specialization and coverage ratios presented in Table 4C-6 show a very high degree of specialization by petroleum refineries in 1987 and 1992: 99 percent of the value of shipments from SIC code 2911 establishments were classified as SIC code 2911 petroleum products. In addition, SIC code 2911 establishments accounted for 99 percent of the value of all petroleum products shipped domestically.

Table 4C-6: Selected Ratios for Petroleum Refineries

SIC Code	Year	Total Number of Firms	Concentration Ratios					Specialization Ratio	Coverage Ratio
			4 Firm (CR4)	8 Firm (CR8)	20 Firm (CR20)	50 Firm (CR50)	Herfindahl-Hirschman Index		
2911	1987	200	32%	52%	78%	95%	435	99%	99%
	1992	132	30%	49%	78%	97%	414	99%	99%

Source: Department of Commerce, Bureau of the Census, Census of Manufactures, 1992.

e. Foreign Trade

The United States consumes more petroleum than it produces, requiring net imports of both crude oil and products to meet domestic demand. In 1997, the U.S. imported 8.23 million barrels per day (MBD) of crude oil, or 56 percent of the total crude oil supply of 14.77 MBD, and imported 1.94 MBD of refined products. These refined product imports represented ten percent of the 18.62 MBD of refined products supplied to U.S. consumers. The U.S. exported 0.9 MBD of refined products in 1997.

Imports of refined petroleum products have fluctuated since 1985. Imports rose to 2.3 MB in the early 1980s, due to rapid growth in oil consumption, especially consumption of light products, which exceeded the growth in U.S. refining capacity. Imports then declined as a result of the 1990/91 recession and a surge in upgrading of refinery capacity resulting primarily from Clean Air Act Amendment and other environmental requirements (U.S. DOE, 1997b). Imports are now increasing and are expected to continue growing through 2002.

Until the early 1980s, petroleum product exports consisted primarily of petroleum coke, because trade in most other products was restricted by allowances. Export license requirements for various petroleum products imposed in 1973 were eliminated in the late 1981, however, and exports of other products began to grow. Petroleum exports continue to include heavy products such as residual fuel oil and petroleum coke, which are produced as co-products with motor gasoline and other light products. Production of these heavier products often exceeds U.S. demand, and foreign demand absorbs the excess. Petroleum coke is the leading petroleum export product, accounting for 30 percent of petroleum exports in 1997, followed by distillate fuel oil (15 percent of exports) and motor gasoline (almost 14 percent) (U.S. DOE, 1997a). Exports generally reflect foreign demand, but other factors influence exports as well. For example, exports of motor gasoline increased due to high prices in Europe at the time of the 1990 Persian Gulf crisis. U.S. refiners and marketers have gained experience in marketing to diverse world markets, and U.S. products are now sold widely abroad (U.S. DOE, 1997b). The real value of petroleum exports fluctuated during the years 1989 to 1996, as reported by the International Trade Administration, with an overall increase of approximately 23 percent over the entire period (see Table 4C-7).

Table 4C-7: Foreign Trade Statistics for Petroleum Refineries

Year	Value of imports ($1999 millions)	Value of exports ($1999 millions)	Value of Shipments ($1999 millions)	Implied Domestic Consumption[1]	Import Penetration[2]	Export Dependence[3]
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1989	11,798	4,318	131,192	138,672	9%	3%
1990	11,656	4,891	130,218	136,983	9%	4%
1991	9,907	5,782	132,272	136,397	7%	4%
1992	9,574	5,413	128,061	132,222	7%	4%
1993	9,535	5,521	127,196	131,210	7%	4%
1994	9,454	5,054	131,182	135,581	7%	4%
1995	8,659	5,269	134,380	137,771	6%	4%
1996	15,971	5,436	136,387	146,922	11%	4%
Average Annual Growth Rate	*4%*	*3%*	*1%*	*1%*	*3%*	*4%*

[1] Implied domestic consumption based on value of shipments, imports, and exports [column d + column b - column c].
[2] Import penetration based on implied domestic consumption and imports [column b / column e].
[3] Export dependence based on value of shipments and exports [column c / column d].

Source: Department of Commerce, International Trade Administration, Outlook Trends Tables.

4C.3 Financial Condition and Performance

Refiners' profitability depends on the spread between product prices and crude oil and other input prices (the gross refining margin), investment costs, and operating costs. Operating costs in turn reflect facility configurations (complexity), scale and efficiency, the mix of high-end versus low-end products produced, and location. Refinery yields vary with refinery configuration, operating practices, and crude oil characteristics. Revenues earned from a barrel of crude depend on the prices of different products, the mix of products produced, and the refinery yield for each product. Relatively small swings in the price of gasoline (which represents the largest product output) and the price of crude oil can cause large changes in cash margins and refinery profits.

Returns on investments to produce higher quality products from a given mix of crude oil (or to produce a given product mix from heavier crude oil) depend on the differentials between high and low quality crude. Price discounts for low quality crude have not always been enough to earn competitive returns on investments in extra coking and sulfur removal capacity.

Throughout the 1990s, the U.S. refining and marketing industry was characterized by unusually low product margins, low profitability, and substantial restructuring. These low profit margins were the result of three different factors: (1) increases in operating costs as a result of governmental regulations; (2) expensive upgrading of processing units to accommodate lower-quality crude oils;[7] and (3) upgrading of operations to adapt to changes in demand for refinery products.[8] A combination of higher cost as a result of these three trends and lower product prices as a result of competitive pressures has led to lower profits (American Petroleum Institute, 1999).

In the late 1990s, the U.S. majors aggressively pursued cost-

[7] Crude oils processed by U.S. refineries have become heavier and more contaminated with materials such as sulfur. This trend reflects reduced U.S. dependence on the more expensive high gravity ("light"), low sulfur ("sweet") crude oils produced in the Middle East and greater reliance on crude oil from Latin America (especially Mexico and Venezuela), which is relatively heavy and contains higher sulfur ("sour") (U.S. DOE, 1999a).

[8] Demand for lighter products such as gasoline and diesel fuel has increased, and demand for heavier products has decreased.

cutting throughout their operations (Rodekohr, 1999). There were improvements in both gross and net margins.[9] Reductions in costs resulted from:

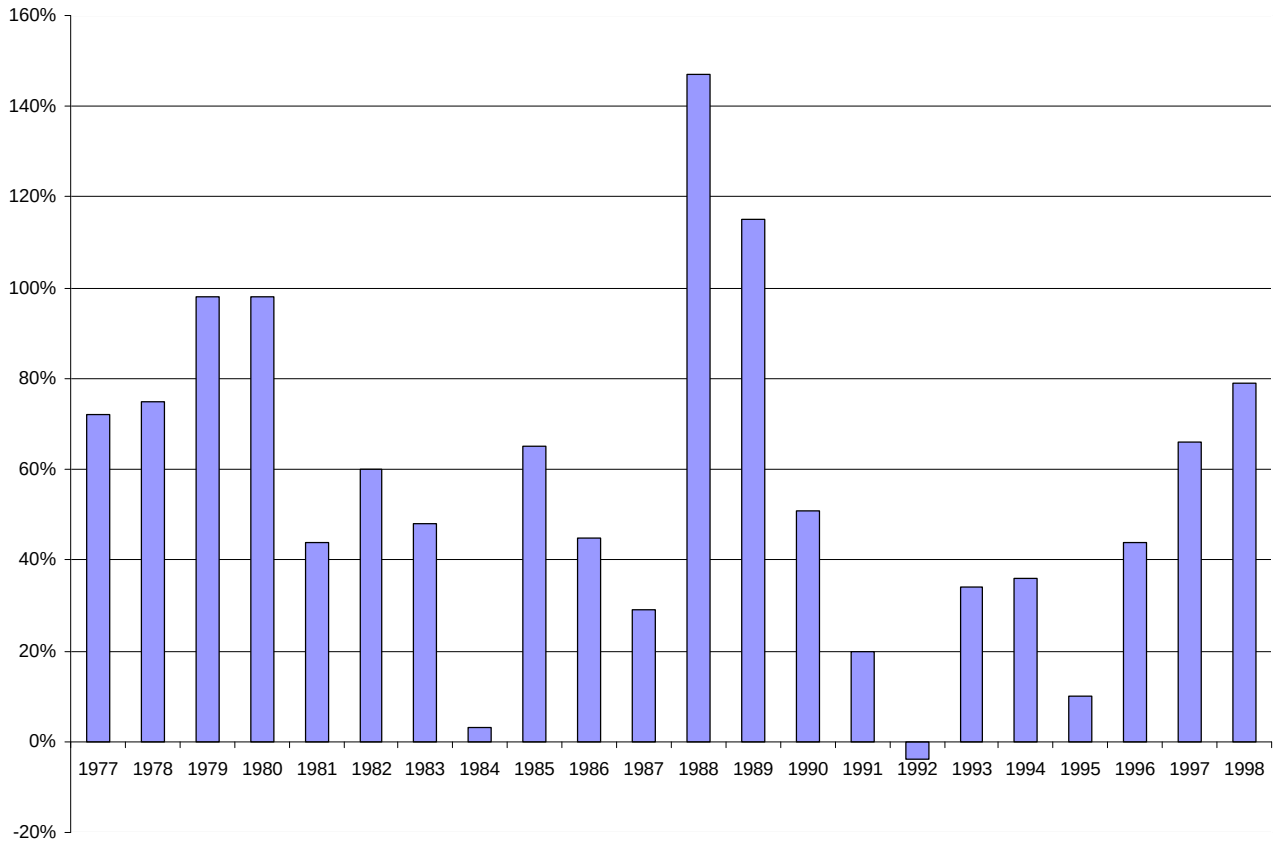
- divesting marginal refineries and gasoline outlets;
- divesting less profitable activities (e.g., gasoline credit cards);
- reducing corporate overhead costs, including eliminating redundancies through restructuring;
- outsourcing some administrative activities; and
- use of new technologies requiring less labor.

Financial performance again declined in 1998, due to low prices and high inventories resulting from reduced worldwide oil demand. Figure 4C-9 shows the substantial fluctuation in return on investment from 1977 through 1996, including the relatively low returns in the early 1990s.[10]

[9] Gross margin is revenues per refined product barrel less raw materials cost (i.e., average product price minus average crude oil cost). Net margin is gross margin minus operating costs (all out-of-pocket refining and retailing expenses such as energy costs and marketing costs.)

[10] The Financial Reporting System (FRS) is described in U.S. DOE, 1997a. Quarterly financial results are collected for a group of specialized refiner/marketers and major integrated petroleum companies. Data are reported separately for their U.S. refining/marketing lines of business. Companies drop in and out of the survey as a result of acquisitions and mergers. Data include only the U.S. operations for foreign affiliates (BP American, Fina, Shell Oil) but worldwide operations for U.S.-based companies. The surveyed companies account for approximately 80 percent of total U.S. companies' worldwide investment in petroleum and natural gas, and approximately 25 percent of worldwide refining capacity (excluding State Energy Companies) (Rodekohr, 1999).

Figure 4C-9: U.S. Petroleum and Natural Gas Refining and Marketing, Return on Investment 1977 - 1996



Source: U.S. DOE, Financial Reporting System (FRS) historical data.

Table 4C-8 below shows trends in estimated operating margins for the petroleum refining industry, based on Census data for SIC code 2911. Margins decreased two percent overall between 1988 and 1996, from 15.6 percent to 13.6 percent. Throughout this period, margins fluctuated, but not sharply.

Table 4C-8: Operating Margins for Petroleum Refineries

Year	Value of Shipments	Cost of Materials	Payroll (all employees)	Operating Margin
1988	$133,729	$109,523	$3,296	15.6%
1989	$131,192	$110,522	$2,984	13.5%
1990	$130,218	$113,167	$2,610	11.1%
1991	$132,272	$112,735	$3,137	12.4%
1992	$128,061	$109,891	$3,418	11.5%
1993	$127,196	$107,933	$3,656	12.3%
1994	$131,182	$107,547	$3,884	15.1%
1995	$134,380	$108,785	$3,750	16.3%
1996	$136,387	$114,654	$3,225	13.6%

Source: Department of Commerce, Bureau of the Census, Annual Survey of Manufactures.

4C.4 Facilities Operating Cooling Water Intake Structures

In 1982, the Petroleum and Coal Products industry (SIC 29) withdrew 590 billion gallons of cooling water, accounting for approximately 0.8 percent of total industrial cooling water intake in the United States. The industry ranked 4th in industrial cooling water use, behind the electric power generation industry, and the chemical and primary metals industries (1982 Census of Manufactures).

This section presents information from EPA's *Industry Screener Questionnaire: Phase I Cooling Water Intake Structures* on existing facilities with the following characteristics:

- they withdraw from the waters of the United States;
- they hold an NPDES permit;
- they have an intake flow of more than two MGD;
- they use at least 25 percent of that flow for cooling purposes.

These facilities are not "new facilities" as defined by the proposed §316(b) New Facility Rule and are therefore not subject to this regulation. However, they meet the criteria of the proposed rule except that they are already in operation. These existing facilities therefore provide a good indication of what new facilities in these sectors may look like. The remainder of this section refers to existing facilities with the above characteristics as "§316(b) facilities."

a. Cooling Water Uses and Systems

Information collected in the Screener Questionnaire found that an estimated 28 out 163 facilities, or 17 percent, meet the characteristics of a §316(b) facility. Ninety-six percent of these facilities use cooling water for production line (or process) contact or noncontact cooling. Approximately 39 and 31 percent of the §316(b) facilities also reported use of cooling water in electricity generation and air conditioning, respectively.

Table 4C-9 shows the distribution of existing §316(b) petroleum refineries by type of water body and cooling system. Thirteen facilities, or 46 percent, obtain their cooling water from either a freshwater stream or river. Thirty-nine percent of refineries obtain their cooling water from either an estuary or a tidal river. The other two sources of cooling water reported for petroleum refineries were oceans and lakes/reservoirs, accounting for approximately seven percent each.

The most common cooling water system used by petroleum refineries is a once-through cooling system, representing approximately 47 percent of all systems used by refineries. Thirty-four percent of all refineries use a closed cycle cooling system. The remaining 18 percent use a combination cooling system. Most §316(b) refineries are located on either an estuary tidal river (11 facilities) or a freshwater river/stream (13 facilities).

Table 4C-9: Number of Petroleum Refining Facilities by Water Body Type and Cooling System Type

Water Body Type	Cooling System						Total
	Closed Cycle		Once Through		Combination		
	Number	% of Total	Number	% of Total	Number	% of Total	
Estuary or Tidal River	2	20%	7	60%	2	20%	11
Freshwater Stream or River	6	50%	4	34%	2	17%	13
Lake or Reservoir	1	49%	1	51%	0	0%	2
Ocean	0	0%	1	50%	1	50%	2
***Total*†**	***10***	***34%***	***13***	***47%***	***5***	***19%***	***28***

† Individual numbers may not add up to total due to independent rounding.

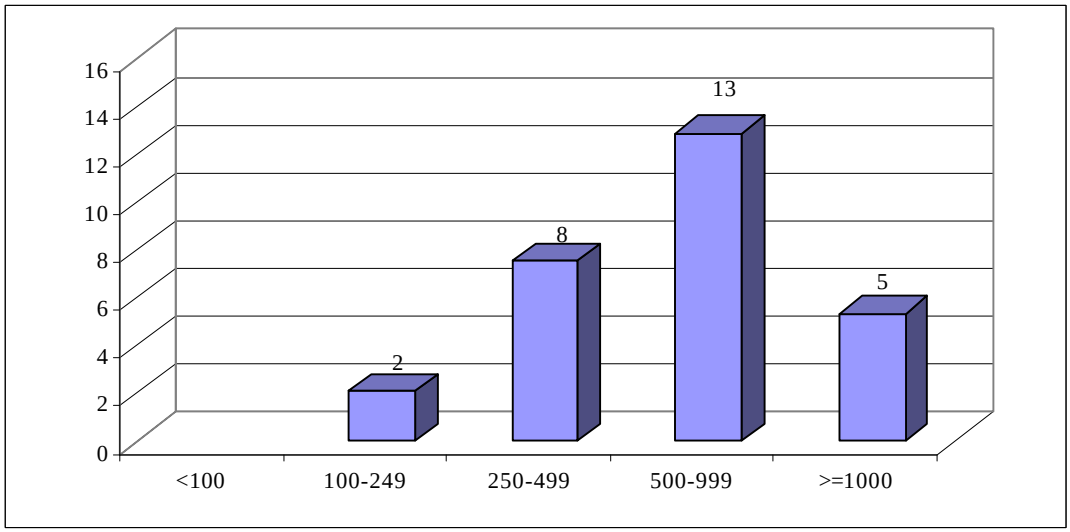
Source: EPA, Industry Screener Questionnaire: Phase I Cooling Water Intake Structures, 1999.

According to the American Petroleum Institute and EPA, water use in the petroleum refining industry has been declining because facilities are increasing their reuse of water. These restrictions are likely to reduce §316(b)-related costs, and a complete phase out of once-through cooling water in refineries is expected (U.S. EPA, 1996).

b. Facility Size

§316(b) facilities in SIC code 2911 are somewhat larger on average than the average employment size distribution of the industry as a whole, as reported in the Census. Figure 4C-10 shows the number of §316(b) facilities by employment size category. Sixty-four percent of §316(b) refineries employ over 500 people and all employ over 100 employees.

Figure 4C-10: Number of §316(b) Petroleum Refineries by Employment Size Category



Source: EPA, Industry Screener Questionnaire: Phase I Cooling Water Intake Structures, 1999.

c. Firm Size

EPA used the Small Business Administration (SBA) small entity thresholds to determine the number of existing §316(b) petroleum refineries owned by small firms. Firms in this industry are considered small if they employ fewer than 1,500 people. Table 4C-10 shows that 92 percent of all §316(b) petroleum refineries are owned by large firms. There are no §316(b) petroleum refining facilities that are owned by a firm known to be small, and only eight percent are owned by a firm of unknown size which might qualify as a small firm.

Table 4C-10: Number of §316(b) Petroleum Refineries by Firm Size

SIC Code	Large		Small		Unknown		Total
	No.	% of SIC	No.	% of SIC	No.	% of SIC	
2911	26	92%	0	0%	2	8%	28

Source: EPA, Industry Screener Questionnaire: Phase I Cooling Water Intake Structures, 1999; D&B Database, 1999.

REFERENCES

American Petroleum Institute. 1999. Policy Analysis and Strategic Planning Department. *Economic State of the US Petroleum Industry*. February 26, 1999.

American Petroleum Institute. undated. *Petroleum Industry Environmental Performance: 6th Annual Report* (STEP report.)

DRI/McGraw Hill and U.S. Department of Commerce, International Trade Administration. 1998. *U.S. Industry and Trade Outlook '98.*

Dun and Bradstreet (D&B). 1999. Data as of April 1999.

Gale Business Resources. 1999. *Petroleum Refining*.

Office of Management and Budget. 1987. *Standard Industrial Classification Manual.*

Office of Management and Budget. 1997. *North American Industry Classification System.*

Rodekohr, Dr. Mark. *Financial Developments in '96-'97: How the U.S. Majors Survived the 1998 Crude Oil Price Storm*, May 27, 1999 presentation, http://www.eia.doe.gov/emeu/finance/highlite7/sld001.htm

U.S. Department of Commerce, Bureau of the Census. 1992(a). Census of Manufactures: Industry Series.

U.S. Department of Commerce, Bureau of the Census. 1996(a). Annual Survey of Manufactures, 1996.

U.S. Department of Commerce, Bureau of the Census. 1996(b). Statistics of U.S. Businesses, 1996.

U.S. Department of Commerce, Bureau of the Census. Current Industrial Reports. *Survey of Plant Capacity*. http://www.census.gov/cir/www/mqc1pag2.html

U.S. Department of Energy (DOE), Financial Reporting System (FRS) historical data, http://www.eia.doe.gov/emeu/aer/finance.html

U.S. Department of Energy (DOE). 1997(a). *Performance Profiles of Major Energy Producers 1995.* DOE/EIA-0615, September. http://www.eia.doe.gov/emeu/perfpro/.

U.S. Department of Energy (DOE). 1997(b). Energy Information Administration. September 1997. *Petroleum 1996: Issues and Trends.* Page 15. DOE/EIA-0615(96). Contact Craig H. Cranston (202) 586-6023.

U.S. Department of Energy (DOE). 1999 (a). Energy Information Administration. *Petroleum: An Energy Profile, 1999*, p. 25.

U.S. Department of Energy (DOE). 1999 (b). Energy Information Administration. *The U.S. Petroleum Refining and Gasoline Marketing Industry. Recent Structural Changes in U.S. Refining: Joint Ventures, Mergers, and Mega-Mergers.* http://www.eia.doe.gov/emeu/finance/usi&to/downstream/. July 9, 1999.

U.S. Department of Energy (DOE). 1999(c). Energy Information Administration. December 17, 1999. "Market Trends - Oil & Natural Gas." *Annual Energy Outlook 2000.* Report#DOE/EIA-0383(2000).

U.S. Department of Energy (DOE). 1999 (d). Energy Information Administration. June 1999. *Petroleum Supply Annual, Volume 1.* http://www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/psa_volume1.html

U.S. Department of Energy (DOE). *Financial News for Independent Energy Companies*, http://www.eia.doe.gov/emeu/perfpro/news_i/index.html

U.S. Department of Energy (DOE). *Financial News for Major Energy Companies*, http://www.eia.doe.gov/emeu/perfpro/news_i/index.html

U.S. Environmental Protection Agency (EPA). 1995. Sector Notebook: *Profile of the Petroleum Refining Industry*. September. EPA 310-R-95-013.

U.S. Environmental Protection Agency (EPA). 1996(a). "Draft: Preliminary Regulatory Development Section 316(b) of the Clean Water Act, Background Paper Number 2: Cooling Water Use for Selected Industries." September 30.

U.S. Environmental Protection Agency (EPA). 1996(b). Office of Water. *Preliminary Data for the Petroleum Refining Category.* July. EPA-821-R-96-016.

U.S. Environmental Protection Agency (EPA). 1996(c). Office of Solid Waste. *Study of Selected Petroleum Refining Residuals: Industry Study*, August. http://www.epa.gov/epaoswer/haswaste/id/studies/studyp.txt

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